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1884

BUILDING MATERIAL  
TESTS.

1882, 1883.

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Commissioners for the Erection of the Public Buildings,

PHILADELPHIA.

12a

# FRANKLIN INSTITUTE LIBRARY

PHILADELPHIA

CLASS 691 BOOK P534 ACCESSION 5600

## REFERENCE

in a library of reference except when required by Committees of the Institute, or by members or holders of second class stock, who have obtained the sanction of the Committee. The second class shall include those books intended for circulation.

ARTICLE VI.—The Secretary shall have authority to loan to members and to holders of second class stock, any work belonging to the SECOND CLASS, subject to the following regulations.

Section 1.—No individual shall be permitted to have more than *two* books out at one time, without a written permission, signed by at least two members of the Library Committee, nor shall a book be kept out more than *TWO WEEKS*; but if no one has applied for it, the former borrower may renew the loan. Should any person have applied for it, the latter shall have the preference.

Section 2.—~~A FINE OF TEN CENTS PER WEEK~~ shall be exacted for the detention of a book beyond the limited time; and if a book be not returned ~~within three~~ months it shall be deemed lost, and the borrower shall, in addition to his fines, forfeit its value.

Section 3.—Should any book be returned injured, the borrower shall pay for the injury, or replace the book, as the Library Committee may direct; and if one or more books, belonging to a set or sets, be lost, the borrower shall replace them or make full restitution.

ARTICLE VII.—Any person removing from the hall, without permission from the proper authorities, any book, newspaper or other property in charge of the Library Committee, shall be reported to the Committee, who may inflict any fine not exceeding twenty-five dollars.

ARTICLE VIII.—No member or holder of second class stock, whose annual contribution for the current year shall be unpaid or who is in arrears for fines, shall be entitled to the privileges of the Library or Reading Room.

ARTICLE IX.—If any member or holder of second class stock, shall refuse or neglect to comply with the foregoing rules, it shall be the duty of the Secretary to report him to the Committee on the Library.

ARTICLE X.—Any member or holder of second class stock, detected in mutilating the newspapers, pamphlets or books belonging to the Institute shall be deprived of his right of membership, and the name of the offender shall be made public.

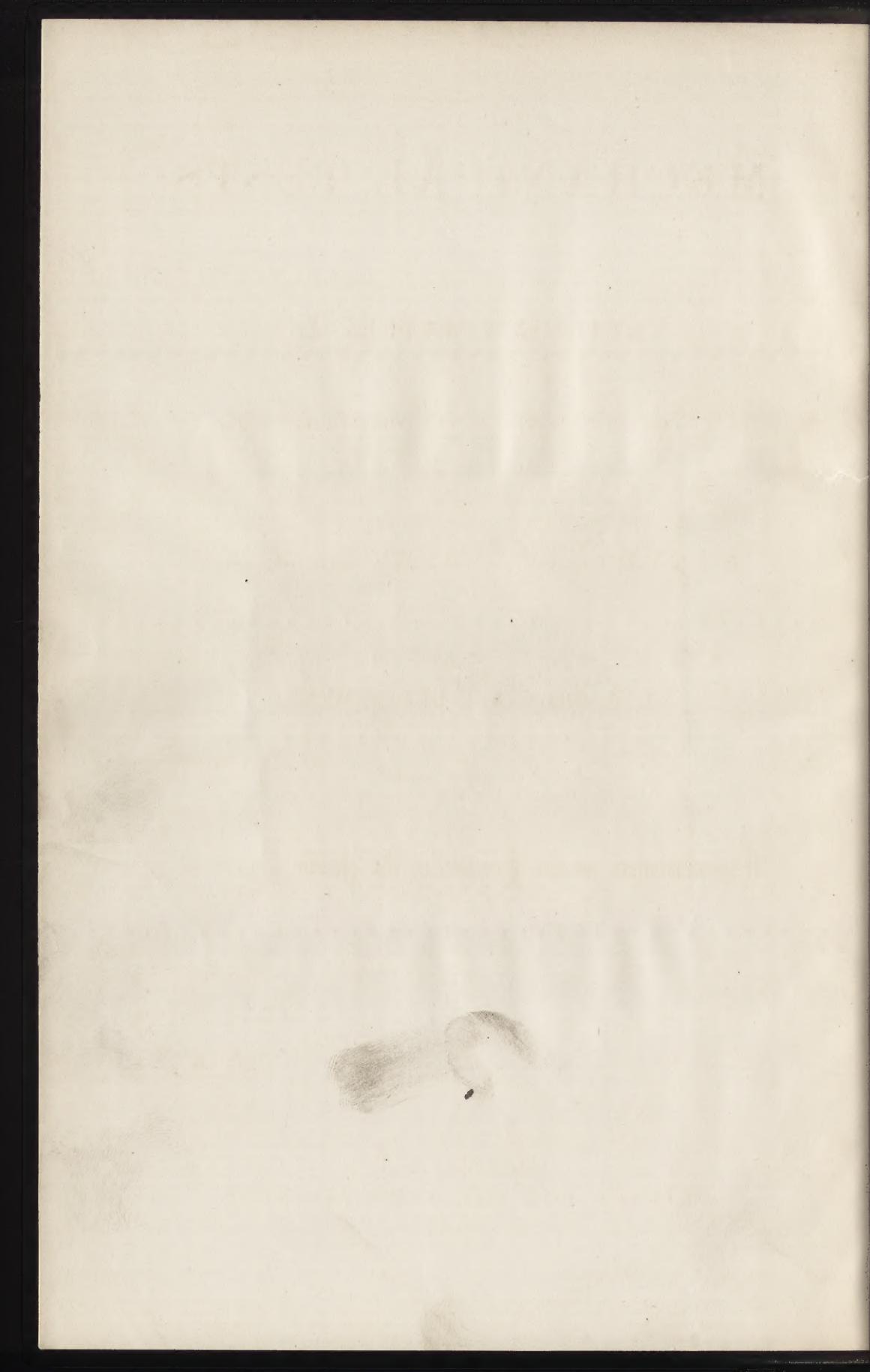
FRANKLIN INSTITUTE  
LIBRARY.

PRESENTED BY

*Sam'l C. Perkins*

5 Mo. 1 1884.

40



# MECHANICAL TESTS

OF

## BUILDING MATERIAL,

MADE AUGUST, 1882, AND NOVEMBER, 1883,

AT THE

WATERTOWN ARSENAL, MASS.,

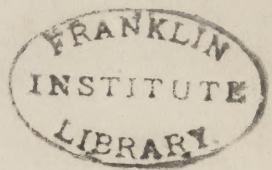
BY THE

U. S. ORDNANCE DEPARTMENT,

AT THE REQUEST OF THE

Commissioners for the Erection of the Public Buildings,

PHILADELPHIA, PA.



PHILADELPHIA:  
PRINTED FOR THE COMMISSIONERS.

1884.



# TEST OF BUILDING MATERIAL,

MADE AT THE WATERTOWN ARSENAL, MASS., AUGUST, 1882,

BY THE

U. S. ORDNANCE DEPARTMENT,

AT THE REQUEST OF THE

Commissioners for the Erection of the Public Buildings

IN THE

CITY OF PHILADELPHIA, PA.

CHIEFLY IN REFERENCE TO THE MATERIAL USED IN THE  
NEW CITY HALL.



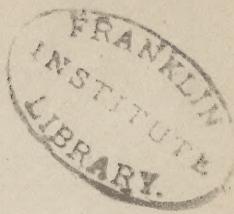
PHILADELPHIA:  
PRINTED FOR THE COMMISSIONERS.

1882.

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PRESS OF HENRY B. ASHMEAD,  
1102 and 1104 Sansom Street.

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Watertown Arsenal, Mass.

AUGUST 21, 1882.

TEST, . . . . . COMPRESSION.

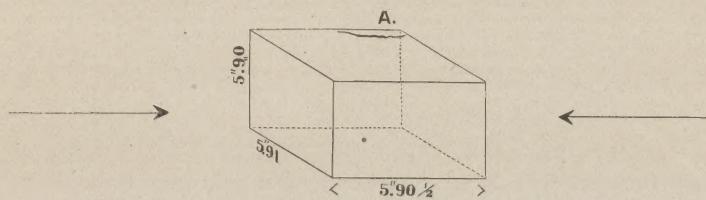
MATERIAL, . . . . BUILDING MATERIAL.

FOR WHOM TESTED, . . CITY OF PHILADELPHIA, PA.

FROM LEE, MASS.

No. 2550.

MARBLE BLOCK L., No. 1, BLUE. On end.



Sectional area, . . . . .  $\square''$  34.87.

".010 brass packing used.

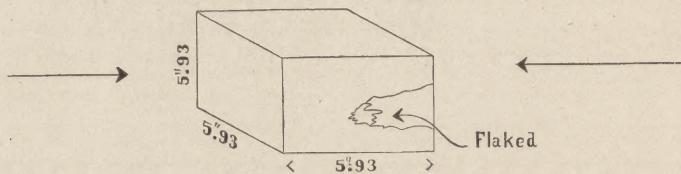
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
544,000		Crack at A appeared high side of specimen.
715,000	20,504	Ultimate strength.

Burst into fragments suddenly.

## FROM LEE, MASS.

No. 2551.

MARBLE L., No. 2, WHITE. On bed.

Sectional area, . . . . .  $\square''$  35.16.

Took even bearings without packing.

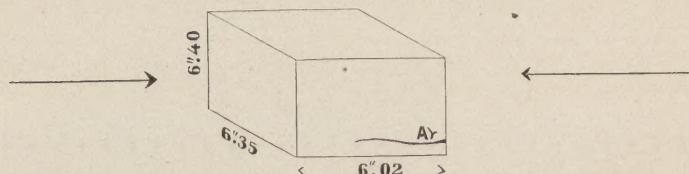
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
		No cracks in sight at 730,000 lbs. Specimen now covered with canvas.
800,000	22,370	Sustained this load, then removed from the machine.

Effect of loading, slight flaking of one face of block.

## FROM MONTGOMERY CO., PA.

No. 2552.

MARBLE P., 1, BLUE. On bed.

Sectional area, . . . . .  $\square''$  40.64.

About ".007" packing under one edge.

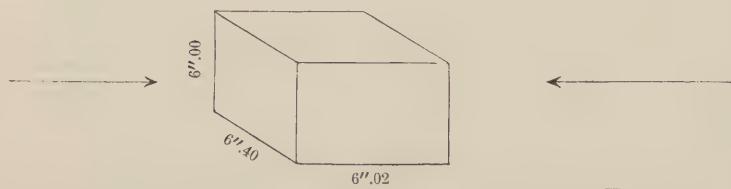
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
400,000		Crack A appeared.
466,300	11,470	Ultimate strength.

Failed immediately after first signs of rapid yielding.

## FROM MONTGOMERY CO., PA.

No. 2554.

MARBLE P., 2, BLUE. On end.

Sectional area, . . . . .  $\square'$  38.4.

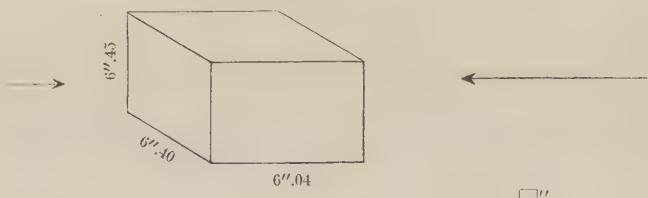
About ".010 packing under one corner.

LOADS APPLIED.	LBS. PER $\square'$	REMARKS.
400,000	10,420	Ultimate strength.  No signs of failure till block burst.

## FROM HUMMELSTOWN, PA.

No. 2555.

SANDSTONE, No. 3. On bed.

Sectional area, . . . . .  $\square'$  41.28.

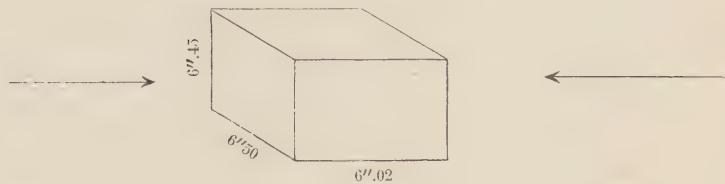
One face flat, one convex; took about ".008 packing.

LOADS APPLIED.	LBS. PER $\square'$	REMARKS.
510,000		Rapid yielding.
528,700	12,810	Ultimate strength.

## FROM HUMMELSTOWN, PA.

No. 2556.

SANDSTONE, No. 1. On end.



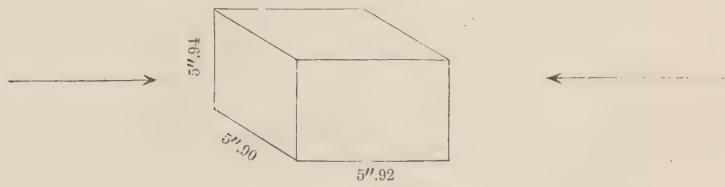
Sectional area, . . . . .  $\square''$  41.92.  
About ".01 packing under three corners.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
543,000		Cracking sounds.
570,300	13,610	Ultimate strength. Burst suddenly.

## FROM CONSHOHOCKEN, PA.

No. 2557.

LIMESTONE C., No. 1. On end.

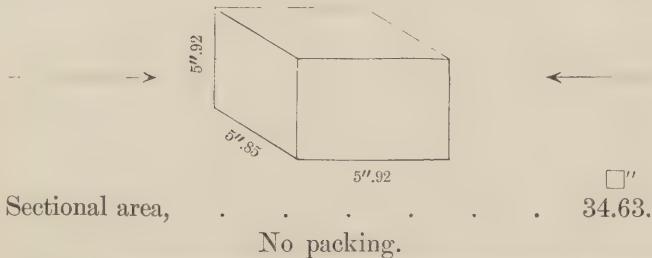


Sectional area, . . . . .  $\square''$  35.05.  
No packing.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
494,000	14,090	Ultimate strength. Failed immediately after first signs of weakness. Block split up along stratification.

## FROM CONSHOHOCKEN, PA.

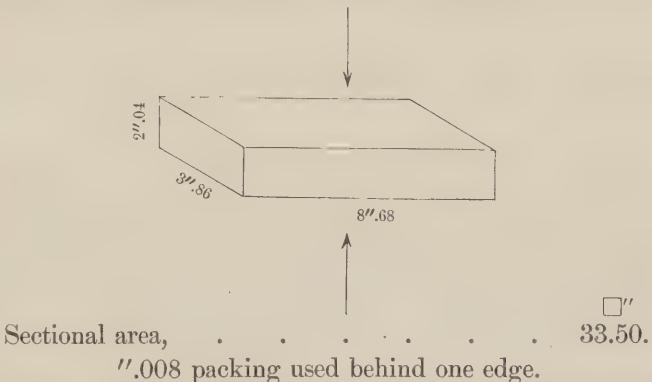
No. 2558. LIMESTONE C., No. 2. On bed.



LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
566,000	16,340	Ultimate strength.  Failed immediately after first signs of weakness.

## PHILADELPHIA, PA.

No. 2559. DOBBINS, HARD BRICK. Machine.

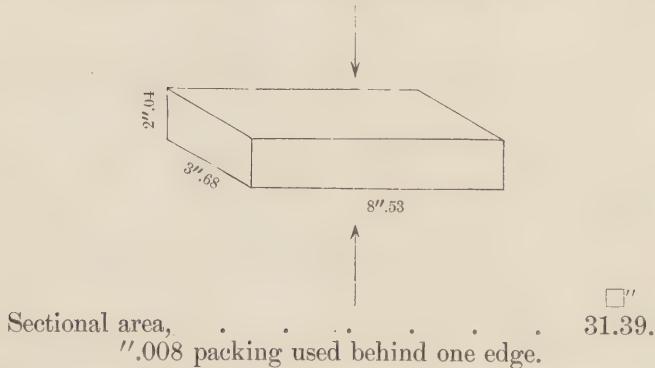


LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
30,000		Crumbling along upper edge; load not evenly distributed.
288,500	8,610	Ultimate strength.

Failure gradually took place. Fractures beginning at high side and extending over whole brick.

## PHILADELPHIA, PA.

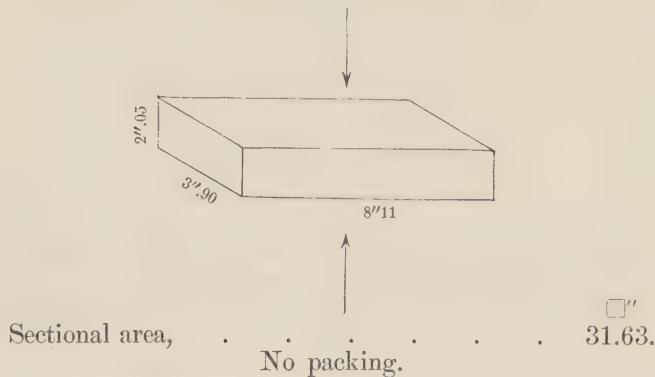
No. 2560. EXCELSIOR HARD BRICK. Machine.



LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
157,000		Cracks in sight at end of brick.
261,000	8,310	Ultimate strength.
Failed by breaking up. Fractures commenced at end of brick.		

## PHILADELPHIA, PA.

No. 2561. J. R. HUHN, HARD BRICK. Hand-made.



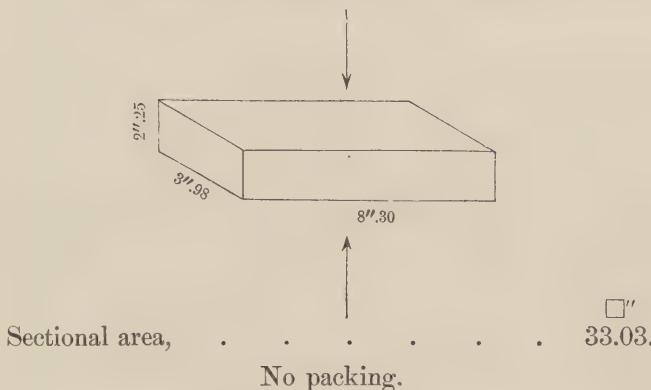
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
228,000		Decided yielding; cracking sounds.
591,000	18,690	Ultimate strength.

Failed suddenly at the very end of test. Gradual yielding had been going on since first cracks appeared at about 230,000 lbs.

## PHILADELPHIA, PA.

No. 2562.

DOTTERER, PRESSED BRICK. Machine.

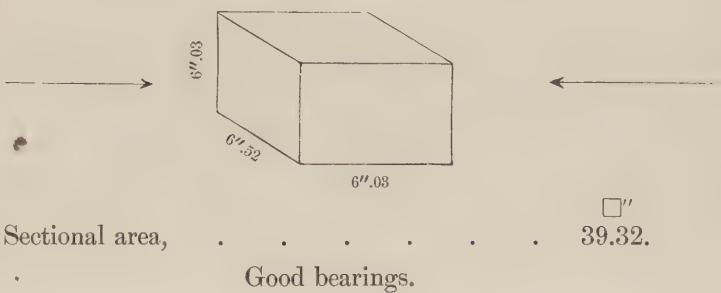


LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
158,000		Flaking at top of brick.
256,500	7,770	Ultimate strength.

## FROM OHIO.

No. 2563.

SANDSTONE, BUFF, O., A. 2. On bed.



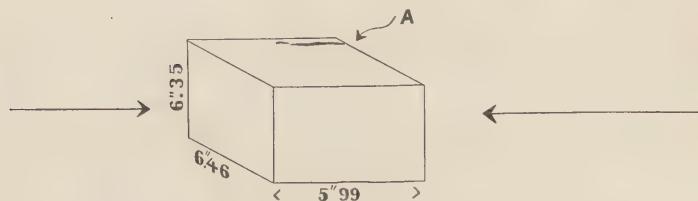
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
253,000		First crack appeared.
256,000	6,510	Ultimate strength.

\*

## FROM OHIO.

No. 2564.

SANDSTONE, BUFF, O., A. 3. On end.

Sectional area, . . . . .  $\square''$  41.02.

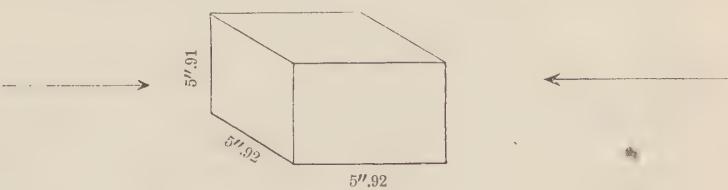
".005 packing along one edge.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
145,000		First crack on side A.
199,500	4,860	Ultimate strength.

## FROM LEE, MASS.

No. 2565.

MARBLE L., No. 3, MIXED WHITE AND BLUE. On end.

Sectional area, . . . . .  $\square''$  34.99.

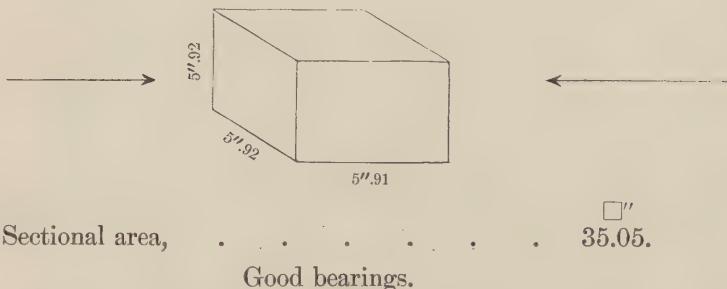
Good bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
800,000	22,860	Sustained maximum load of testing machine without apparent injury.

## FROM LEE, MASS.

No. 2566.

MARBLE L., No. 4, WHITE. On end.

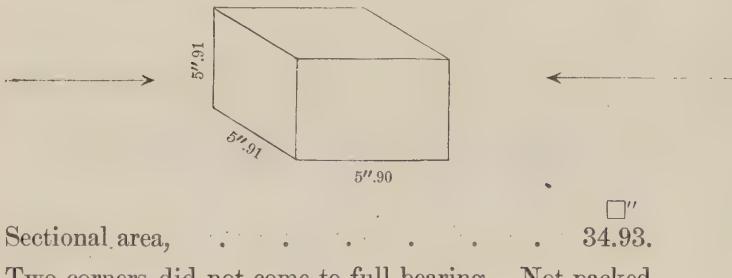


LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
800,000	22,820	Sustained maximum load of testing machine without perceptible injury.

## FROM LEE, MASS.

No. 2567.

MARBLE L., No. 5, BLUE. On bed.

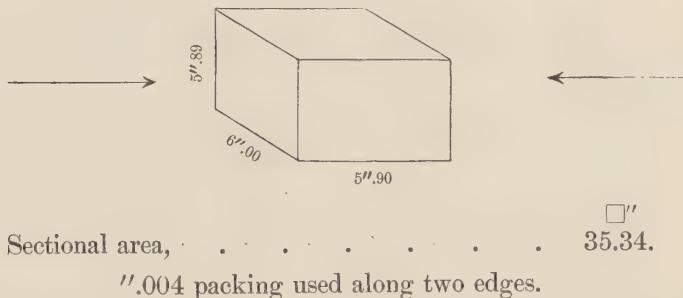


LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
800,000	22,900	Sustained maximum load of testing machine.  Flaked off along one edge.

## FROM LEE, MASS.

No. 2568.

MARBLE L., No. 6, MIXED WHITE AND BLUE. On bed.



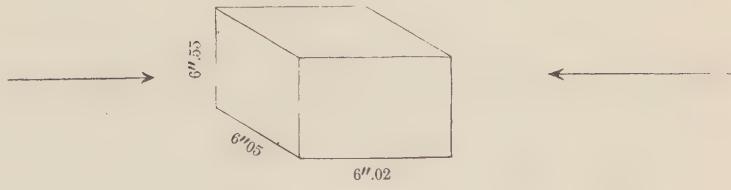
Sectional area, . . . . .  $\square''$  35.34.  
 $''$ .004 packing used along two edges.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
610,000		Cracks first appear.
767,000	21,700	Ultimate strength. Crushed suddenly with report.

## FROM MONTGOMERY CO., PA.

No. 2569.

MARBLE P., 3, BLUE. On bed.



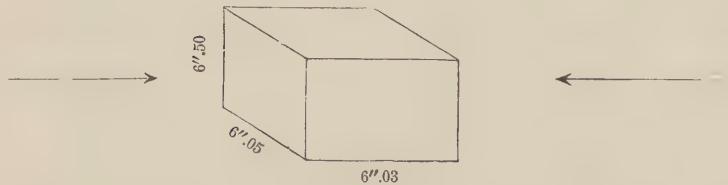
Sectional area, . . . . .  $\square''$  39.63.  
 $''$ .006 packing under one corner.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
543,000	13,700	Ultimate strength.

FROM MONTGOMERY CO., PA.

No. 2570.

MARBLE P., 4, BLUE. On end.



Sectional area, . . . . . 39.33.

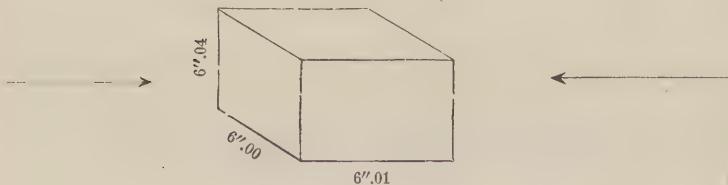
Ends take good bearings.

LOADS APPLIED.	LBS. PER <input type="checkbox"/> "	REMARKS.
398,000	10,120	Ultimate strength.

FROM MONTGOMERY CO., PA.

No. 2571.

MARBLE P., 5, BLUE. On end.



Sectional area, . . . . . 36.24.

About ".01 packing used behind ends.

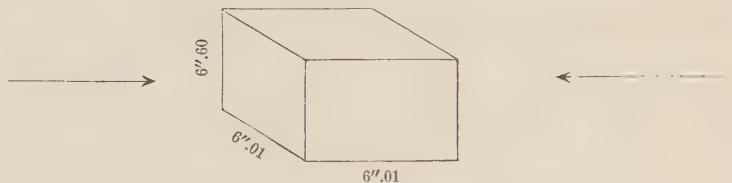
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
347,500	9,590	Ultimate strength.

Probable reduction in strength from uneven bearing.

## FROM MONTGOMERY CO., PA.

No. 2572.

MARBLE P., 6, BLUE. On bed.



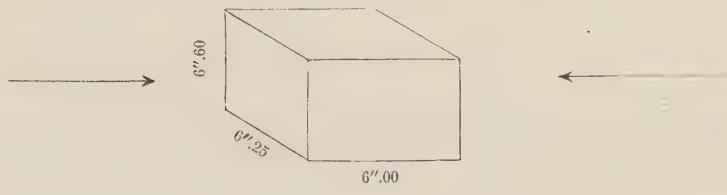
Sectional area, . . . . .  $\square''$  39.67.  
Good bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
434,000	10,940	Ultimate strength.

## FROM OHIO.

No. 2573.

SANDSTONE, BUFF, O., A. 1. On bed.



Sectional area, . . . . .  $\square''$  41.25.  
One end convex, about  $'.01\frac{1}{2}$ ; no packing used.

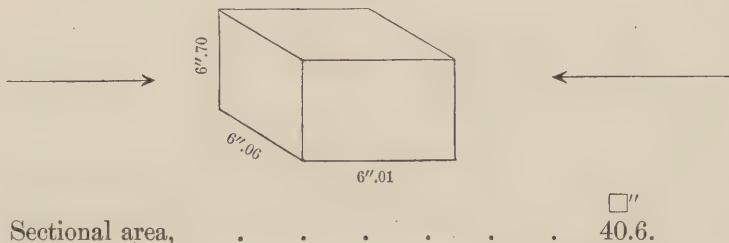
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
252,000		Specimen began to crack.
289,500	7,020	Ultimate strength.



## FROM OHIO.

No. 2574.

SANDSTONE, BUFF, O., A. 4. On end.



Sectional area, . . . . . 40.6.

Uneven bearings. Load received on one corner. Maximum opening about .02. No packing.

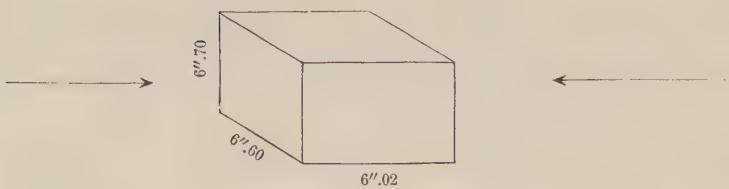
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
90,000		Crack opposite high corner.
160,000	3,940	Ultimate strength.

Specimen broke in detail, owing to imperfect bearings concentrating load on one corner.

## FROM INDIANA.

No. 2575.

LIMESTONE I., 1. On end.

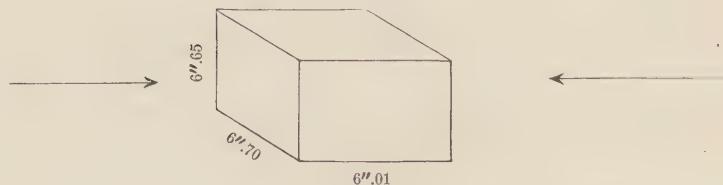
Sectional area, . . . . . 44.22.  
Good bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
377,000	8,530	Ultimate strength.

## FROM INDIANA.

No. 2576.

LIMESTONE I., 2. On end.

Sectional area,                                   $\square''$  44.56.

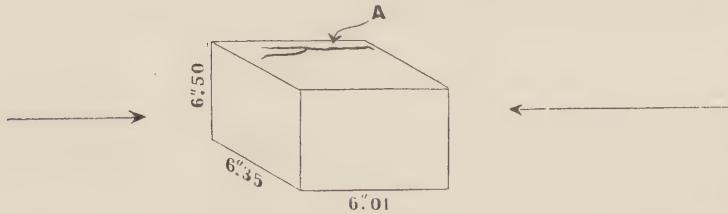
Good bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
320,500	7,190	Ultimate strength.

## FROM INDIANA.

No. 2577.

LIMESTONE I., 3. On bed.

Sectional area,                                   $\square''$  41.28.

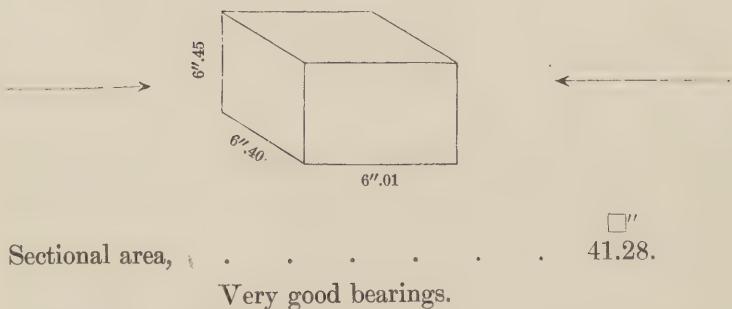
Good bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
295,000		Cracks appeared at A.
321,000	7,776	Ultimate strength.

## FROM INDIANA.

No. 2578.

LIMESTONE I., 4. On bed.

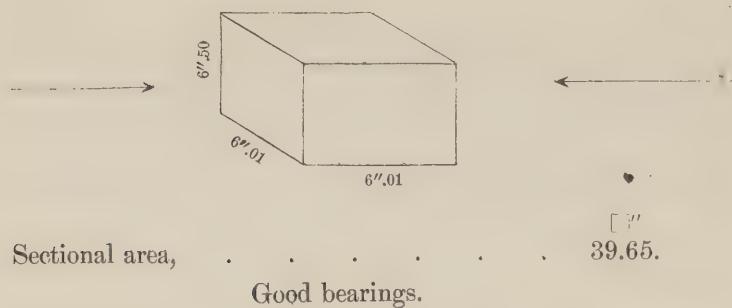


LOADS APPLIED.	LBS. PER $\square'$	REMARKS.
438,300	10,620	Ultimate strength.

## FROM VERMONT.

No. 2579.

DOVE-COLORED MARBLE D., 1. On bed.



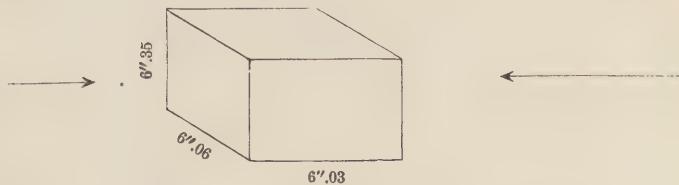
LOADS APPLIED.	LBS. PER $\square'$	REMARKS.
531,200	13,400	Ultimate strength.

\*\*

## FROM VERMONT.

No. 2580.

DOVE-COLORED MARBLE D., 2. On end.



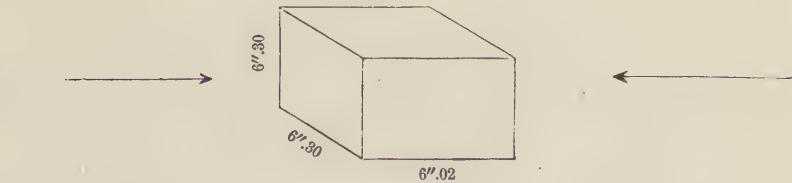
Sectional area, . . . . .       $\square''$       38.48.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
379,800	9,870	Ultimate strength.

## FROM OHIO.

No. 2581.

SANDSTONE, BLUE, O., 1. On end.



Sectional area, . . . . .       $\square''$       39.69.

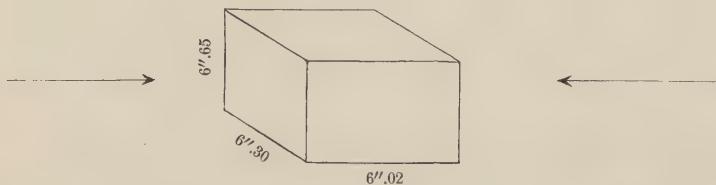
Fair bearings.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
305,000	7,680	Ultimate strength.

## FROM OHIO.

No. 2582.

SANDSTONE, BLUE, O., 2. On bed.



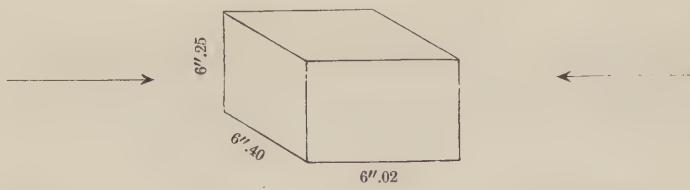
Sectional area, . . . . . 41.90.  
 ".005 packing behind one corner.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
435,400	10,400	Ultimate strength.  Fractured suddenly with loud report.

## FROM OHIO.

No. 2583.

SANDSTONE, BLUE, O., 3. On end.



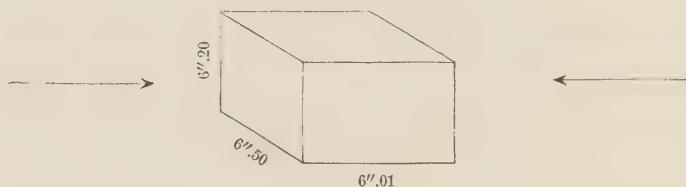
Sectional area, . . . . . 40.  
 ".004 packing at two corners. Surface generally came to good bearing.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
391,800	9,795	Ultimate strength.

## FROM OHIO.

No. 2584.

SANDSTONE, BLUE, O., 4. On bed.

Sectional area, . . . . .  $\square''$  40.30.

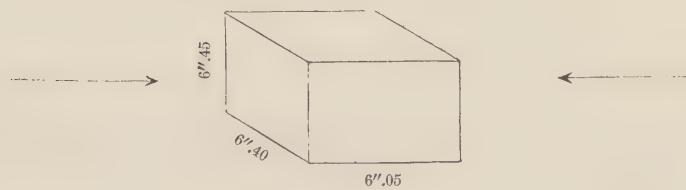
Imperfect bearing. ".007 packing used behind one edge.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
297,000		Small piece flaked off side.
351,000	8,710	Ultimate strength.

## FROM OHIO.

No. 2585.

SANDSTONE, BLUE, No. 2. On end.

Sectional area, . . . . .  $\square''$  41.28.  
Fair bearings.

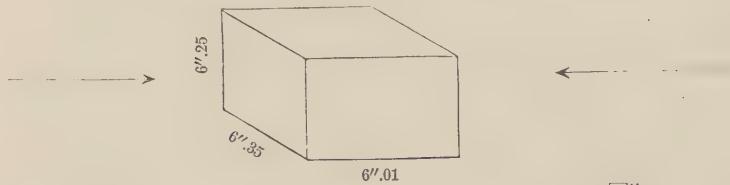
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
620,000		Snapping sounds.
672,100	16,280	Ultimate strength. Fractured suddenly with loud report.



## FROM OHIO.

No. 2586.

SANDSTONE, BLUE, No. 4. On bed.



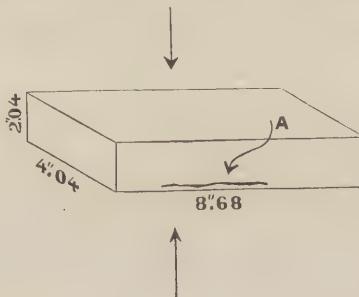
Sectional area, . . . . . 39.74.  
 ".005 packing under one edge.

LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
456,000		Cracks appear and stone flaked off at one corner.
493,500	12,420	Ultimate strength.

## PHILADELPHIA, PA.

No. 2587.

DOBBINS, HARD BRICK. Machine.



Sectional area, . . . . . 35.07.  
 Good bearings.

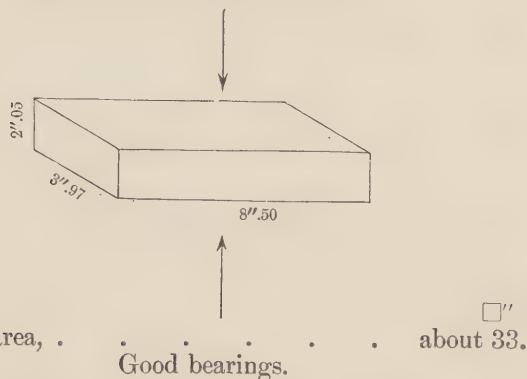
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
162,000		First cracks appear at A.
411,000	11,720	Ultimate strength.

Cracks were gradually developed after 162,000 lbs. load was passed, rapidly failing near the close of the test.

## PHILADELPHIA, PA.

No. 2588. DOBBINS, HARD BRICK. Machine.

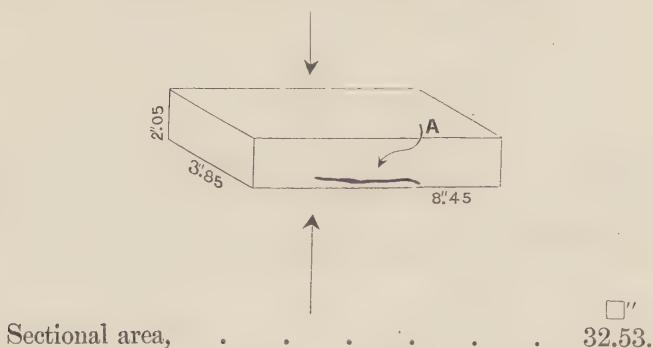
One corner broken off before test.



LOADS APPLIED.	LBS. PER □"	REMARKS.
120,000		Crack started at corner.
290,000		Rapid yielding.
304,000	9,210	Ultimate strength.

## PHILADELPHIA, PA.

No. 2589. EXCELSIOR HARD BRICK. Machine.

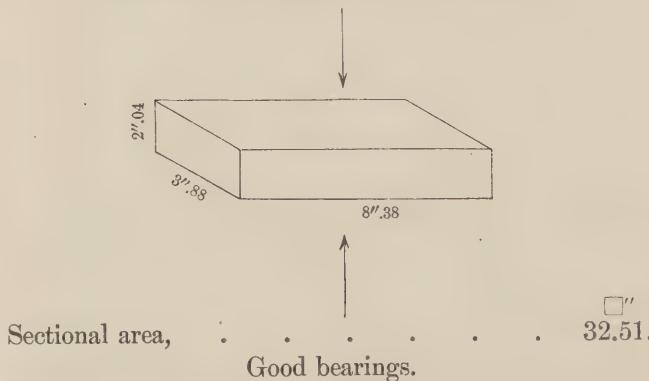


LOADS APPLIED.	LBS. PER □"	REMARKS.
98,000		Cracked at A.
180,200	5,540	Ultimate strength.

## PHILADELPHIA, PA.

No. 2590.

EXCELSIOR HARD BRICK. Machine.

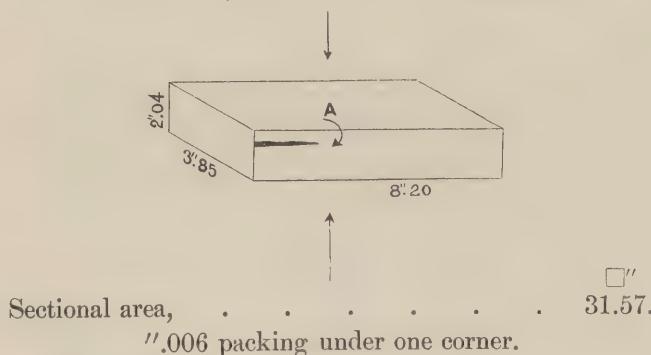


LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
130,000		Crack started near corner.
188,100	5,790	Ultimate strength.

## PHILADELPHIA, PA.

No. 2591.

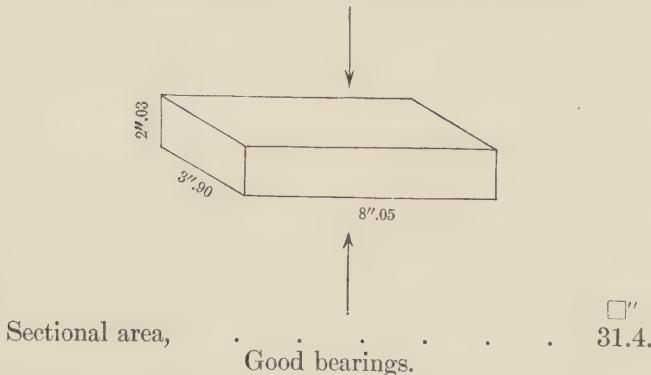
J. R. HUHN, HARD BRICK. Hand-made.



LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
95,000		Crack at A opened.
346,400	10,970	Ultimate strength.

No. 2592. PHILADELPHIA, PA.

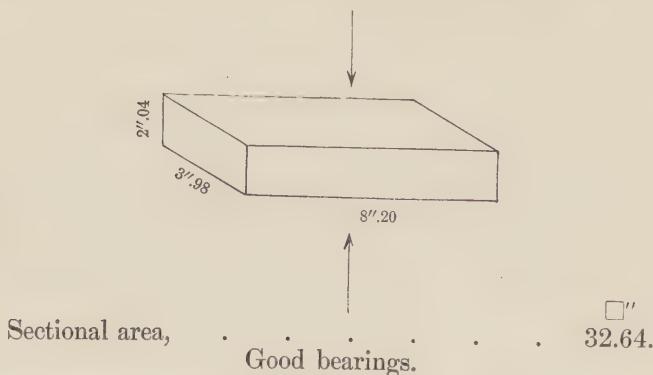
J. R. HUHN, HARD BRICK. Hand-made.



LOADS APPLIED.	LBS. PER □"	REMARKS.
350,000		Brick cracked at end.
654,000	20,830	Ultimate strength.

No. 2593. PHILADELPHIA, PA.

J. R. HUHN, HARD BRICK. Hand-made.

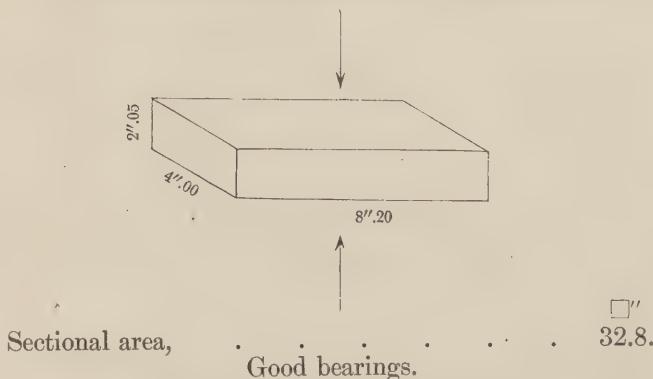


LOADS APPLIED.	LBS. PER □"	REMARKS.
235,000		First crack.
364,000	11,150	Ultimate strength.

## PHILADELPHIA, PA.

No. 2594.

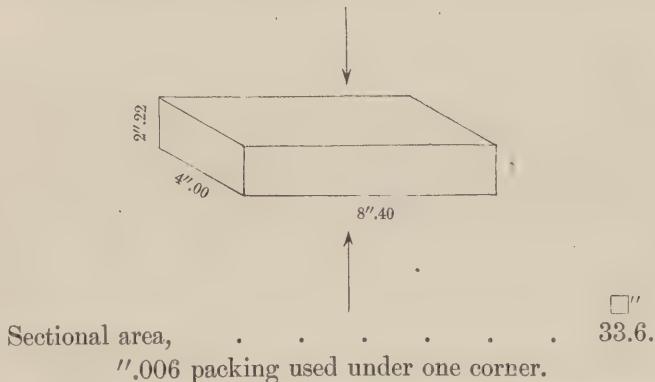
J. R. HUHN, HARD BRICK. Hand-made.



LOADS APPLIED.	LBS. PER □"	REMARKS.
206,000		Cracking sound; crack not in sight.
382,000	11,650	Ultimate strength.

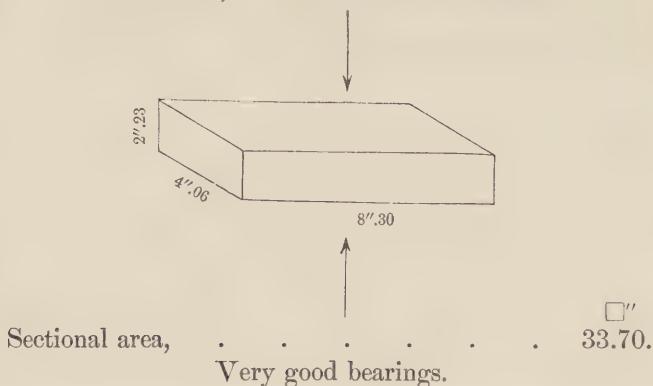
No. 2595.

DOTTERER, PRESSED BRICK. Machine.



LOADS APPLIED.	LBS. PER □"	REMARKS.
85,000		First crack.
304,000	9,050	Ultimate strength.

## No. 2596. DOTTERER, PRESSED BRICK. Machine.



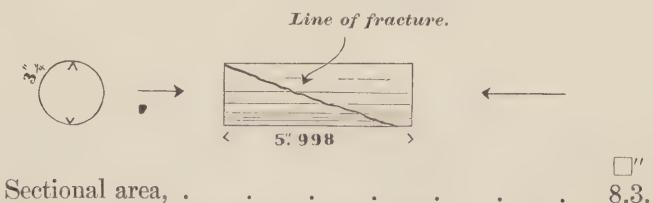
LOADS APPLIED.	LBS. PER $\square''$	REMARKS.
160,000		First crack.
243,000	7,210	Ultimate strength.

## COMPRESSION OF CAST IRON.

Specimens Nos. 2597, 2598, 2599, have the same quantity of cast iron in each, differing in form. Castings dressed only on bearing surfaces.

## No. 2597.

## FORM OF SPECIMEN, SOLID.



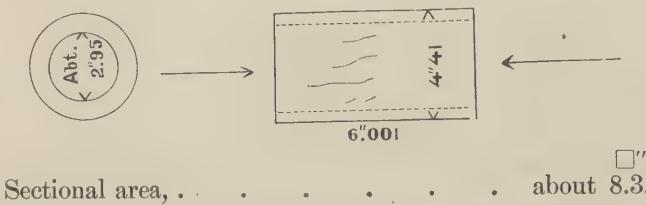
LOADS APPLIED.	LBS. PER $\square''$	COMPRES-	COMPRES-	REMARKS.
		SION.	SION SET.	
41,500	5,000		0	Loads released to zero and
83,000	10,000		0	compression sets measured
124,500	15,000			after each increment of
166,000	20,000		.002	5000 lbs. per $\square''$
207,500	25,000		.005	
249,000	30,000		.012	



LOADS APPLIED.	LBS. PER $\square''$	COMPRES-SION.	COMPRES-SION SET.	REMARKS.
290,500	35,000		".023	
332,000	40,000		.041	
373,500	45,000		.071	
415,000	50,000		.122	
456,500	55,000		.207	
498,000	60,000		.406	
501,000	60,360			Ultimate strength.

Oblique fracture, making an angle of about 30 degrees with axis of specimen. Sides swelled.

No. 2598. FORM OF SPECIMEN, OPEN CYLINDER.



Sectional area, . . . . . about  $\square''$  8.3.

LOADS APPLIED.	LBS. PER $\square''$	COMPRES-SION.	COMPRES-SION SET.	REMARKS.
41,500	5,000		0	
83,000	10,000		0	
124,500	15,000		".001	
166,000	20,000		.002	
207,500	25,000		.004	
249,000	30,000		.007	
290,500	35,000		.011	
332,000	40,000		.020	
373,500	45,000		.034	
415,000	50,000		.058	
456,500	55,000		.090	
498,000	60,000		.136	
539,500	65,000		.217	
566,000	68,190			Ultimate strength.

Sides swelled. Oblique fractures opening at middle on the outside of the specimen.

## No. 2599. FORM OF SPECIMEN, OPEN CYLINDER.



Sectional area, . . . . . about 8.3.  $\square''$

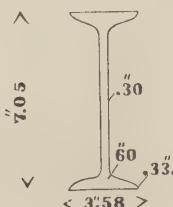
LOADS APPLIED.	LBS. PER $\square''$	COMPRE- SSION.	COMPRE- SSION SET.	REMARKS.
41,500	5,000		0	
83,000	10,000		0	
124,500	15,000		".0001 $\frac{1}{2}$	
166,000	20,000		.001	
207,500	25,000	about	.001 $\frac{1}{2}$	
249,000	30,000		.002	
290,500	35,000		.002 $\frac{1}{2}$	
332,000	40,000		.003	
373,500	45,000		.006	
415,000	50,000		.010	
456,500	55,000		.015	
498,000	60,000		.025	
539,500	65,000		.035	
581,000	70,000		.052	
622,500	75,000		.074	
657,600	79,230			Ultimate strength.

Strains were gradually applied. When the ultimate load was reached the load on the scale of the testing machine fell off about 3000 lbs. Strains were now released, the specimen uncovered and examined; no cracks were in sight. When again loaded the specimen fractured, with a loud report, at about 655,000 lbs. There were twenty-five pieces after fracture.

## COMPRESSION OF WROUGHT IRON I BEAMS.

No. 2600.

Length of specimen, 6".004.



Sectional area,       $\square''$       5.2.

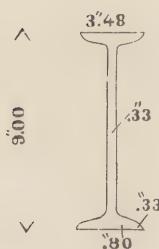
LOADS APPLIED.	LBS. PER $\square''$	COMPRES- SION.	COMPRES- SION SET.	REMARKS.
26,000	5,000		0	
52,000	10,000		.001	
104,000	20,000		.002	
130,000	25,000		.002	
145,000	28,000		.002*	
156,000	30,000		.003	
166,400	32,000		.004	
176,800	34,000		.007	
187,200	36,000		.032	
197,600	38,000		.042	
208,000	40,000		.054	
218,400	42,000		.065	
228,800	44,000		.081	
239,200	46,000		.100	
249,600	48,000		.124	Web buckled.
260,000	50,000		.156	
282,000	54,230			Ultimate strength.

Flanges buckled outward. Strains continued till specimen was shortened to 5".40, longitudinal seams opening in web.

## WROUGHT IRON I BEAM.

No. 2601.

Length, 6".000.



Sectional area,

6.5.

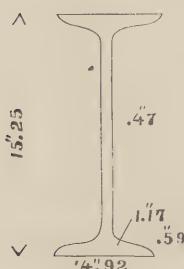
LOADS APPLIED.	LBS. PER □"	COMPRES- SION.	COMPRES- SION SET.	REMARKS.
32,500	5,000		0	
65,000	10,000		0	
130,000	20,000		".000*	
162,500	25,000		.000*	
182,000	28,000		.000*	
195,000	30,000		.000*	
208,000	32,000		.001	
221,000	34,000		.002*	
234,000	36,000		.004	
247,000	38,000		.028	
260,000	40,000		.042	
273,000	42,000		.053	
286,000	44,000		.067	
325,000	50,000		.143	Web buckled.
353,000	54,810			Ultimate strength.

Failed in the same manner as No. 2600.

## WROUGHT IRON I BEAM.

No. 2602.

Length, 6".002.



Sectional area,

 $\square''$   
15.

LOADS APPLIED.	LBS. PER $\square''$	COMPRES- SION.	COMPRES- SION SET.	REMARKS.
75,000	5,000		0	
150,000	10,000		0	
300,000	20,000		0*	
375,000	25,000		0*	
420,000	28,000		0*	
450,000	30,000		0*	
480,000	32,000		0*	
510,000	34,000		/.005	
540,000	36,000		.022	
570,000	38,000		.033	
600,000	40,000		.048	
630,000	42,000		.060	
660,000	44,000		.079	Web buckled.
750,000	50,000		.30	
800,000	53,330		.67	Gradual yielding under this load.

Opened longitudinal cracks in web, buckled web and flanges.

T. T. J. LAIDLEY,

*Colonel of Ordnance, Commanding.*

## MARBLE.

Page.	Locality.	Color.	Direction of Pressure.	Total load applied.	Crushing force on a square inch, in lbs. avoid rupt.	Sectional area, in square inches.	REMARKS.		Register number of experiment.
3	Lee, Mass.,	Blue,	End,	715,000	20,504	34.87	Burst into fragments,	2550	
4	do.	White,	Bed,	800,000	22,370	35.16	Slight flaking on one face,	2551	
10	do.	W. & B.	End,	800,000	22,860	31.99	Without apparent injury,	2563	
11	do.	White,	End,	800,000	22,820	35.05	do. do.	2566	
11	do.	Blue,	Bed,	800,000	22,900	34.93	Flaked off along one edge,	2567	
12	do.	W. & B.	Bed,	767,000	21,703	35.34	Crushed suddenly,	2568	
4	Montgomery Co., Pa.	Blue,	Bed,	466,300	11,170	40.64	Failed suddenly,	2552	
5	do.	Blue,	End,	400,000	10,420	38.40	do. do.	2554	
12	do.	Blue,	Bed,	543,000	13,700	39.63	Ultimate strength,	2569	
13	do.	Blue,	End,	398,000	10,120	39.33	do. do.	2570	
13	do.	Blue,	End,	347,500	9,590	36.24	do. do.	2571	
14	do.	Blue,	Bed,	434,000	10,940	39.67	do. do.	2572	

## LIMESTONE.

6	Conshohocken, Pa.,	End,	494,000	14,090	35.05	Ultimate strength,	2557	
7	do.	Bed,	565,000	16,340	34.63	do. do.	2558	
15	Indiana,	End,	377,000	8,530	44.22	do. do.	2573	
16	do.	End,	320,500	7,190	44.56	do. do.	2576	
16	do.	Bed,	321,000	7,776	41.38	do. do.	2577	
17	do.	Bed,	438,300	10,620	41.28	do. do.	2578	

## DOVE-COLORED MARBLE.

17	Vermont,	Bed,	531,200	13,400	39.65	Ultimate strength,	2579	
18	do.	End,	379,800	9,870	38.48	do. do.	2580	

## SANDSTONE.

5	Hummelstown, Pa.,	Bed,	528,700	12,810	41.28	Ultimate strength,	2555	
6	do.	End,	570,300	13,610	41.92	do. do.	2556	
9	Ohio,	Buff,	256,000	6,510	39.32	do. do.	2563	
10	do.	Buff,	199,500	4,860	41.02	do. do.	2564	
14	do.	Buff,	289,500	7,020	41.25	do. do.	2573	
15	do.	Buff,	160,000	3,940	40.06	Bearings imperfect,	2574	
18	do.	Blue,	305,000	7,680	39.69	Ultimate strength,	2581	
19	do.	Blue,	435,400	10,400	41.90	do. do.	2582	
19	do.	Blue,	391,800	9,795	40.00	do. do.	2583	
20	do.	Blue,	351,000	8,710	40.30	do. do.	2584	
20	do.	Blue,	672,100	16,280	41.28	Fractured suddenly with loud report,	2585	
21	do.	Blue,	493,500	12,420	39.74	Ultimate strength,	2586	

## BRICK.

Page.	Manufacturer.	Quality.	Make.	Total load applied.	Crushing force, in pounds per square inch.	Area of sample, in inches.	REMARKS.		Number of experiment.
7	Dobbins,	Hard,	Machine,	288,500	8,610	33.50	Failure gradually took place,	2559	
21	do.	do.	Machine,	411,000	11,720	35.07	Failed rapidly near close of test,	2587	
22	do.	do.	do.	304,000	9,210	33.00	Ultimate strength,	2588	
8	Excelsior,	do.	do.	261,000	8,310	31.39	Failed by breaking up,	2560	
22	do.	do.	do.	180,200	5,540	32.53	Ultimate strength,	2589	
23	do.	do.	do.	188,100	5,790	32.51	do. do.	2590	
8	J. R. Huhn,	do.	Hand,	591,000	18,690	31.63	Failed suddenly at very end of test,	2561	
23	do.	do.	do.	346,400	10,970	31.57	Ultimate strength,	2591	
24	do.	do.	do.	654,000	20,830	31.4	do. do.	2592	
24	do.	do.	do.	364,000	11,150	32.64	do. do.	2593	
25	do.	do.	do.	382,000	11,650	32.8	do. do.	2594	
9	Dotterer,	Pressed,	Machine,	256,500	7,770	33.03	do. do.	2562	
25	do.	do.	do.	304,000	9,050	33.6	do. do.	2595	
26	do.	do.	do.	243,000	7,210	33.70	do. do.	2596	

## CAST IRON.

Page.	Form of specimen.	Diameter.	Length.	Total load applied.	Crushing force, in pounds per square inch.	Area of sample in inches.	REMARKS.	Number of experiment.
26	Solid cylinder,	3"	5' <sup>9</sup> .998	501,000	60,360	8.3	Oblique fracture. Sides swelled,	2597
27	Open cylinder, do.	4" <sup>4</sup> .41	6' <sup>9</sup> .001	566,000	68,190	8.3	Sides swelled.	2598
28		8" <sup>7</sup> .78	5' <sup>9</sup> .998	657,600	79,230	8.3	Fractured into twenty-five pieces,	2599

## WROUGHT IRON.

Page.	Form of specimen.	Height.	Length.	Total load applied.	Crushing force, in pounds per square inch.	Area of sample in inches.	REMARKS.	Number of experiment.
29	Rolled I beam,	7" <sup>0</sup> .05	6' <sup>0</sup> .004	282,000	54,230	5.2	Flanges buckled outwards,	2600
30	do.	9" <sup>0</sup> .00	6' <sup>0</sup> .000	353,000	54,310	6.5	do. do.	2601
31	do.	15" <sup>0</sup> .25	6' <sup>0</sup> .002	800,000	53,330	15.	Web and flanges buckled,	2602

# COMMISSIONERS

## For the Erection of the Public Buildings.

OCTOBER 1, 1882.

---

WILLIAM BRICE,	SAMUEL G. KING,
ISAAC S. CASSIN,	WILLIAM H. LEX,
SAMUEL W. CATTELL,	HIRAM MILLER,
MAHLON H. DICKINSON,	RICHARD PELTZ,
THOMAS E. GASKILL,	SAMUEL C. PERKINS,
JOHN L. HILL,	WILLIAM B. SMITH,
WILLIAM H. WRIGHT.	

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## OFFICERS.

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SECRETARY—FRANCIS DE HAES JANVIER.

TREASURER—J. J. MARTIN.

SOLICITOR—CHARLES H. T. COLLIS.

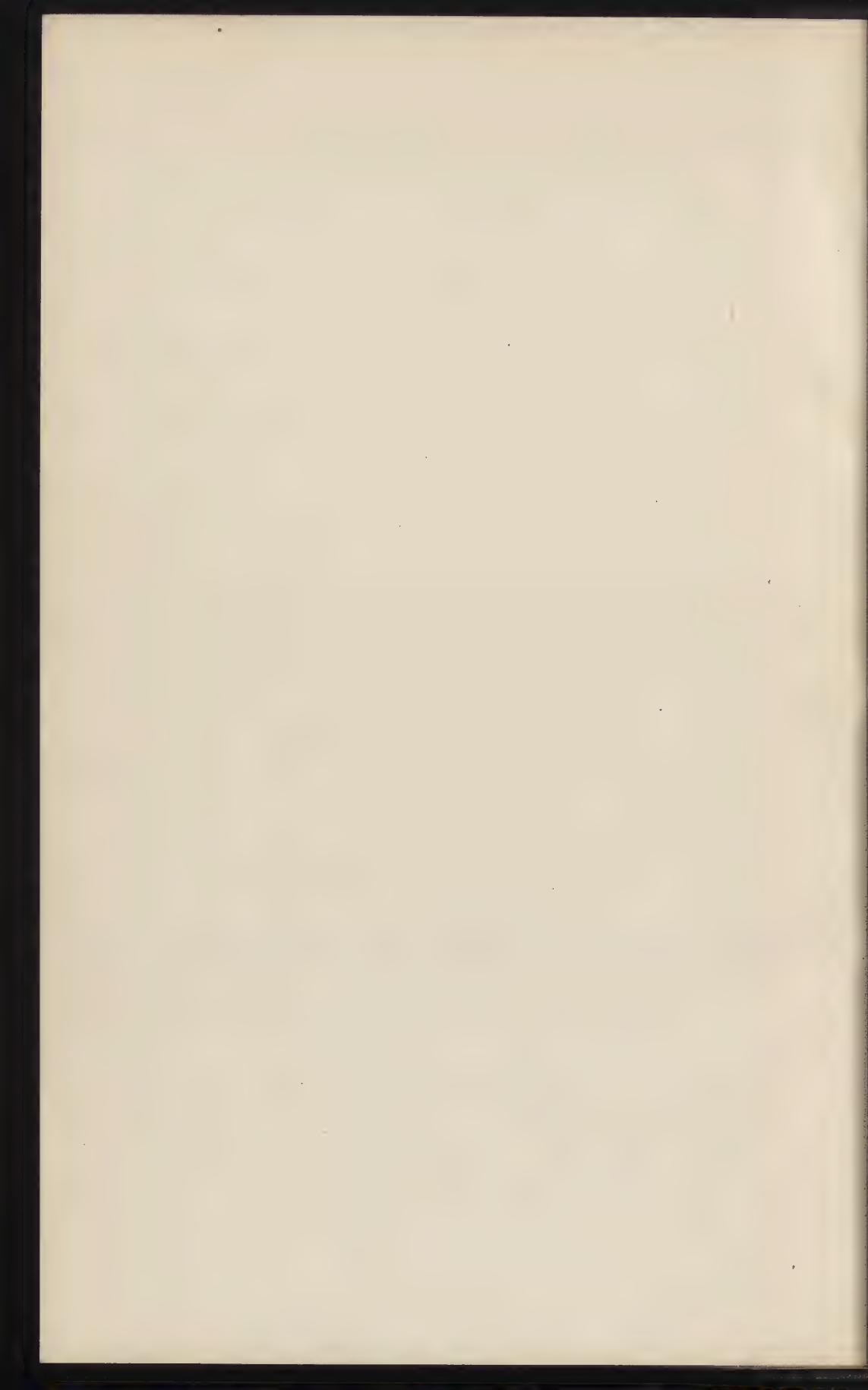
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ARCHITECT—JOHN McARTHUR, JR.

ASSISTANTS—{ JOHN ORD,  
THOMAS U. WALTER.

SUPERINTENDENT—WILLIAM C. MCPHERSON.





# MECHANICAL TESTS

MADE WITH THE

U. S. TESTING MACHINE,

(CAPACITY, 800,000 POUNDS,)

AT

WATERTOWN ARSENAL, MASS.,

NOVEMBER 5, 1883,

BY THE

U. S. ORDNANCE DEPARTMENT,

AT THE REQUEST OF THE

*Commissioners for the Erection of the Public Buildings,*

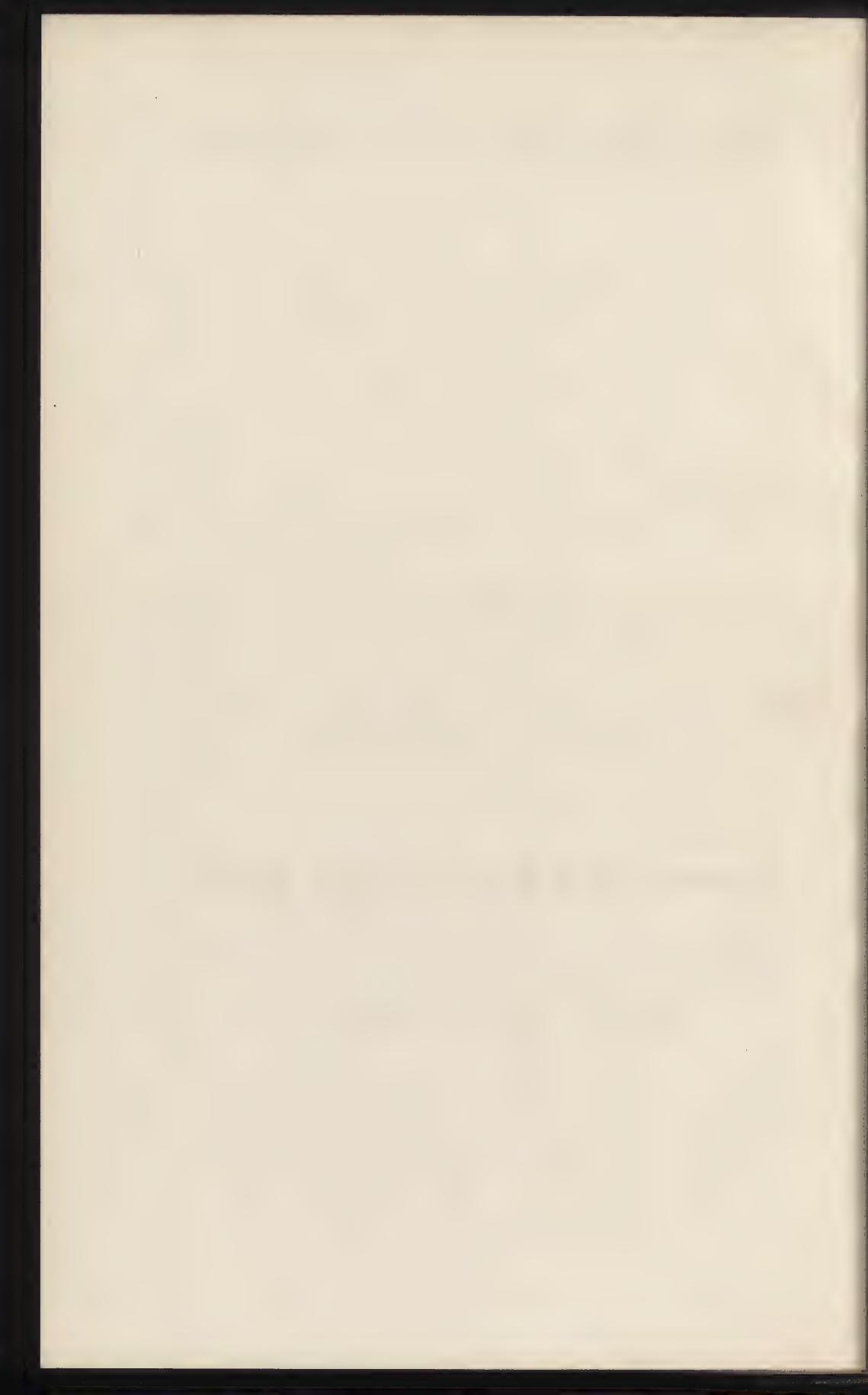
IN THE

CITY OF PHILADELPHIA, PA.

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TESTS BY COMPRESSION,

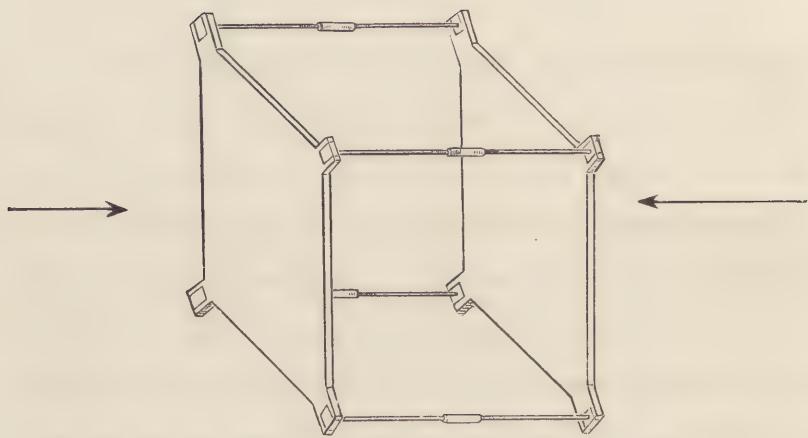
T W E L V E   B R I C K   P I E R S.



THE Piers were tested between flat compression platforms.

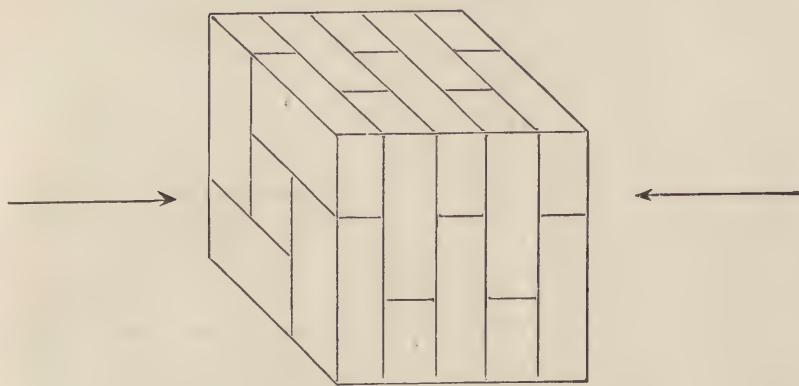
The covering plates of cast iron at the ends of the piers were allowed to remain in position, removing the tie-bolts during the tests.

The compression measurements and sets were determined by a micrometer, secured at either end to the compression platforms of the Testing Machine; thus indicating the total amount of compression which occurred as each increment of load was applied to the piers. Upon the removal of the loads to the initial 5000 lbs., the amount of permanent set was found.



Plates of Cast Iron, enclosing brick piers, planed true on both sides, and made perfectly parallel by means of the swivel tie-bolts.

## STYLE OF PIERS.



## MARKS ON PIER.

No. 3255.

A. 1. DOBBINS, LIME. August 14, 1882.

Length, 12".75.

□"

Sectional area, 12".75 × 13".00 = 165.75.

Weight, 147 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0030		
15,000		.0065		
20,000		.0092		
25,000		.0120		
30,000		.0141		
35,000		.0160		
40,000		.0180		
45,000		.0200		
50,000		.0220		
5,000			.0130	
50,000		.0230		
60,000		.0260		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square\text{ ft}$	Compression, inches.	Set, inches.	
70,000		.0290		
80,000		.0325		
90,000		.0375		
100,000		.0410		
5,000			.0245	
100,000		.0430		
110,000		.0460		
120,000		.0500		
130,000		.0520		
140,000		.0558		
150,000		.0610		
5,000			.0360	
150,000		.0635		
160,000		.0665		
170,000		.0700		
180,000		.0745		
190,000		.0800		
200,000		.0850		
5,000			.0520	
200,000		.0910		
210,000		.0945		
220,000		.1000		
230,000		.1160		
231,000				Rapid disintegration going on.
231,000				Sustained this load about five minutes, slow crushing taking place in the meantime.
239,000	1,442			Ultimate strength.
230,000				Load on pier when test was discontinued.

Pier generally disintegrated.

Correct.

J. E. HOWARD.

## MARKS ON PIER.

No. 3256.

A. 2. DOBBINS, LIME. August 14, 1882.

Length, 12".75.

Sectional area, 12".75 × 12".75 = 162.56.

Weight, 145 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0025		
15,000		.0055		
20,000		.0075		
25,000		.0096		
30,000		.0110		
35,000		.0130		
40,000		.0150		
45,000		.0165		
50,000		.0180		
5,000			.0100	
60,000		.0210		
70,000		.0240		
80,000		.0265		
90,000		.0292		
100,000		.0330		
5,000			.0180	
100,000		.0340		
110,000		.0360		
120,000		.0390		
130,000		.0420		
140,000		.0460		Snapping sounds. Slight
150,000		.0492		crack opened in 4th course
5,000			.0280	of bricks.
150,000		.0520		
160,000		.0540		
170,000		.0570		
180,000		.0610		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
190,000		.0650		
200,000		.0685		
5,000			.0405	
200,000		.0740		
210,000		.0770		
220,000		.0820		
230,000		.0890		
240,000		.1040		
250,000		.1200		
259,100	1,594			Ultimate strength.
240,000				Load on pier when test was discontinued.

After the first cracks appeared, there was a gradual development of longitudinal seams as the pressure was increased, till the maximum load was reached.

Correct.

J. E. HOWARD.

No. 3257.

MARKS ON PIER.

B. 1. DOBBINS, CEMENT. August 14, 1882.

Length, 12 $\frac{1}{2}$ .75.

Sectional area, 13 $\frac{1}{2}$ .00  $\times$  13 $\frac{1}{2}$ .00 = 169.00.

Weight, 148 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0025		
15,000		.0050		
20,000		.0075		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
25,000		.0100		
30,000		.0115		
35,000		.0130		
40,000		.0150		
45,000		.0162		
50,000		.0180		
5,000			.0090	
50,000		.0185		
60,000		.0210		
70,000		.0230		
80,000		.0260		
90,000		.0285		
100,000		.0310		
5,000			.0150	
100,000		.0322		
110,000		.0345		
120,000		.0370		
130,000		.0390		
140,000		.0410		
142,000				First cracking sound.
150,000		.0450		
5,000			.0240	
150,000		.0480		
160,000		.0500		
170,000		.0520		
180,000		.0540		Cracks in sight in middle
190,000		.0570		course.
200,000		.0610		
5,000			.0320	
200,000		.0642		
210,000		.0670		
220,000		.0695		
230,000		.0720		
240,000		.0755		
250,000		.0810		
260,000		.0853		



APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
270,000		.0900		
280,000		.0925		
290,000		.0970		
300,000		.1020		
310,000		.1104		
356,900	2,112			Ultimate strength.
340,000				Load on pier when test was discontinued.

Correct.

J. E. HOWARD.

## No. 3258.

## MARKS ON PIER.

B. 2. DOBBINS, CEMENT. August 14, 1882.

Length, 12''.65.

Sectional area,  $12''.75 \times 12''.75 = 162.56$ .

Weight, 144 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0030		
15,000		.0060		
20,000		.0078		
25,000		.0090		
30,000		.0110		
35,000		.0120		
40,000		.0130		
45,000		.0140		
50,000		.0150		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000			.0075	
60,000		.0170		
70,000		.0182		
80,000		.0200		
90,000		.0210		
100,000		.0230		
5,000			.0100	
100,000		.0240		
110,000		.0250		
120,000		.0260		
130,000		.0275		
140,000		.0290		
150,000		.0302		
5,000			.0120	
150,000		.0315		
160,000		.0325		
170,000		.0338		
180,000		.0350		
190,000		.0365		
200,000		.0380		
5,000			.0145	
200,000		.0390		
210,000		.0400		
220,000		.0410		
230,000		.0430		
240,000		.0435		
250,000		.0450		
260,000		.0465		
270,000		.0480		
280,000		.0500		
290,000		.0510		
300,000		.0530		Cracking sounds. Opened cracks in three inside courses, flaking at end course.
310,000		.0560		
320,000		.0580		
330,000		.0600		
340,000		.0620		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
350,000		.0640		
360,000		.0680		
370,000		.0695		
380,000		.0730		
390,000		.0820		
400,000		.0855		
410,000		.0900		
420,000	2,584	.1000		Ultimate strength.

Correct.

J. E. HOWARD.

No. 3259.

## MARKS ON PIER.

No. 3. HUHN, LIME. August 14, 1882.

Length, 12''.90.

Sectional area,  $12''.50 \times 12''.50 = 156.25$ .

Weight, 138 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0030		
15,000		.0065		
20,000		.0090		
25,000		.0110		
30,000		.0130		
35,000		.0155		
40,000		.0170		
45,000		.0190		
50,000		.0210		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000			.0110	
50,000		.0220		
60,000		.0250		
70,000		.0290		
78,000				Snapping sounds. No cracks in sight.
80,000		.0335		
90,000		.0370		
100,000		.0410		
5,000			.0230	
100,000		.0430		
110,000		.0465		
120,000		.0530		
130,000		.0565		
140,000		.0615		
150,000		.0660		
5,000			.0390	
150,000		.0695		
160,000		.0735		Gradual development of longitudinal cracks.
170,000		.0785		
180,000		.0845		
190,000		.0890		
200,000		.0940		
5,000			.0590	
200,000		.1025		
210,000		.1055		
220,000		.1100		
230,000		.1170		
240,000		.1220		
250,000		.1310		
260,000		.1390		
270,000		.1460		
280,000		.1550		
290,000		.1690		
299,000	1,914	.18		Ultimate strength.

Correct.

J. E. HOWARD.

No. 3260.

## MARKS ON PIER.

No. 4. HUHN, CEMENT. August 14, 1882.

Length, 12".82.

Sectional area, 12".50 × 12".75 = 159.38.

Weight, 140 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0025		
15,000		.0050		
20,000		.0065		
25,000		.0080		
30,000		.0095		
35,000		.0110		
40,000		.0120		
45,000		.0135		
50,000		.0150		
5,000			.0070	
50,000		.0150		
60,000		.0170		
70,000		.0185		
80,000		.0200		
90,000		.0220		
100,000		.0240		
5,000			.0100	
100,000		.0240		
110,000		.0255		
120,000		.0270		
130,000		.0290		
140,000		.0300		
150,000		.0315		
5,000			.0130	
150,000		.0325		
160,000		.0338		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
170,000		.0351		
180,000		.0364		
190,000		.0380		
200,000		.0395		
5,000			.0160	
200,000		.0410		
210,000		.0420		
220,000		.0435		
230,000		.0450		
240,000		.0470		
250,000		.0480		
5,000			.0190	
250,000		.0500		
260,000		.0515		
270,000		.0525		
280,000		.0540		
290,000		.0560		
300,000		.0580		
310,000		.0605		
320,000		.0620		Cracking sounds. Cracks appear in middle and outside courses.
330,000		.0640		
340,000		.0670		
350,000		.0690		
360,000		.0720		
370,000		.0755		
380,000		.0800		
390,000		.0850		
400,000		.0890		
410,000		.0925		
420,000		.0965		
428,000	2,685	.1060		Ultimate strength.
410,000				Load sustained when test was discontinued.

Correct.

J. E. HOWARD.

No. 3261.

## MARKS ON PIER.

No. 5. DOTTERER, PRESSED, CEMENT. August 14, 1882.

Length, 13".20.

Sectional area, 12".50 × 12".50 = 156.25.

Weight, 138 lbs.

APPLIED LOADS.	IN GAUGED LENGTH.			REMARKS.
	Total lbs.	Lbs. per □"	Compression, inches.	
5,000			0	
10,000			.0040	
15,000			.0075	
20,000			.0100	
25,000			.0120	
30,000			.0140	
35,000			.0160	
40,000			.0175	
45,000			.0190	
50,000			.0210	
5,000				.0080
50,000			.0210	
60,000			.0240	
70,000			.0260	
80,000			.0285	
90,000			.0310	
100,000			.0330	
5,000				.0130
100,000			.0340	
110,000			.0360	
120,000			.0380	
130,000			.0400	
140,000			.0420	
150,000			.0440	Second and fourth courses cracked opposite joints of adjacent courses.
5,000				
150,000			.0460	
160,000			.0480	
170,000			.0500	

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
180,000		.0520		
190,000		.0545		
200,000		.0570		
5,000			.0220	
200,000		.0585		
210,000		.0600		
220,000		.0625		
230,000		.0660		
240,000		.0700		
250,000	1,600	.0770		Ultimate strength.
230,000				Load sustained when test was discontinued.

Correct.

J. E. HOWARD.



No. 3262.

## MARKS ON PIER.

No. 6. DOTTERER, PRESSED, LIME. August 14, 1882.

Length, 12''.95.

Sectional area, 12''.50  $\times$  12''.50 = 156.25.

Weight, 133 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0025		
15,000		.0050		
20,000		.0070		
25,000		.0085		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square'$	Compression, inches.	Set, inches.	
30,000		.0105		
35,000		.0120		
40,000		.0135		
45,000		.0150		
50,000		.0165		
5,000			.0070	
50,000		.0170		
60,000		.0200		
70,000		.0230		
80,000		.0255		
90,000		.0290		
100,000		.0320		
5,000			.0125	
100,000		.0332		
110,000		.0360		
120,000		.0400		Cracks started in 3d and 4th courses.
130,000		.0450		
140,000		.0500		
150,000		.0590		
160,000		.0640		
170,000		.0700		
180,000		.0800		
182,400	1,167			Ultimate strength.
175,000				Load sustained when test was discontinued.

Correct.

J. E. HOWARD.

No. 3263.

## MARKS ON PIER.

D. 7. EXCELSIOR, CEMENT. August 14, 1882.

Length, 12".60.

□"

Sectional area, 12".75 × 12".75 = 162.56.

Weight, 135 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0035		
15,000		.0060		
20,000		.0075		
25,000		.0090		
30,000		.0105		
35,000		.0120		
40,000		.0130		
45,000		.0145		
50,000		.0160		
5,000			.0075	
50,000		.0165		
60,000		.0180		
70,000		.0200		
80,000		.0225		
90,000		.0245		
100,000		.0275		
5,000			.0130	
100,000		.0280		
110,000		.0300		
120,000		.0315		
130,000		.0340		
140,000		.0360		
150,000		.0410		
160,000		.0425		
170,000		.0455		
180,000		.0480		
190,000		.0520		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
200,000		.0555		
5,000			.0285	
200,000		.0590		
210,000		.0630		
220,000		.0645		
230,000		.0690		
240,000		.0730		Cracks in sight in middle
250,000		.0800		course.
260,000		.0880		
268,900	1,654	.0980		Ultimate strength.
				Correct.
				J. E. HOWARD.

No. 3264.

## MARKS ON PIER.

D. 8. EXCELSIOR, CEMENT. August 14, 1882.

Length, 12''.65.

Sectional area, 12''.75  $\times$  12''.75 = 159.38.

Weight, 133 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0020		
15,000		.0040		
20,000		.0060		
25,000		.0075		
30,000		.0090		
35,000		.0105		
40,000		.0120		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square'$	Compression, inches.	Set, inches.	
45,000		.0130		
50,000		.0140		
5,000			.0055	
50,000		.0150		
60,000		.0170		
70,000		.0190		
80,000		.0210		
90,000		.0235		
100,000		.0260		
5,000			.0110	Snapping sounds. No cracks in sight.
100,000		.0280		
110,000		.0290		
120,000		.0315		
130,000		.0335		
140,000		.0365		
150,000		.0390		
5,000			.0165	
150,000		.0405		
160,000		.0425		
170,000		.0450		
180,000		.0480		
190,000		.0525		
200,000		.0545		
5,000			.0250	
200,000		.0580		
210,000		.0600		
220,000		.0630		Cracks in 2d course.
230,000		.0680		
240,000		.0710		
250,000		.0770		
260,000		.0855		
266,500	1,672	.0950		Ultimate strength.
235,000				Load sustained when test was discontinued.

Correct.

J. E. HOWARD.

No. 3265.

## MARKS ON PIER.

E. 9. EXCELSIOR, LIME. August 14, 1882.

Length, 12".40.

Sectional area, 12".60 × 12".60 = 158.76.

Weight, 128 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per □"	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0050		
15,000		.0090		
20,000		.0120		
25,000		.0145		
30,000		.0165		
35,000		.0190		
40,000		.0205		
45,000		.0225		
50,000		.0240		
5,000			.0130	
50,000		.0250		
60,000		.0280		
70,000		.0310		
80,000		.0340		
90,000		.0370		
100,000		.0400		
5,000			.0205	
100,000		.0420		
110,000		.0440		
120,000		.0470		
130,000		.0500		
140,000		.0550		
150,000		.0580		
5,000			.0310	
150,000		.0620		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
160,000		.0660		Cracks in sight in four courses.
170,000		.0730		Ultimate strength.
178,800	1,126	.0930		Load sustained when test was discontinued.
150,000				

Correct.

J. E. HOWARD.

No. 3266.

## MARKS ON PIER.

E. 10. EXCELSIOR, LIME. August 14, 1882.



Length, 12''.60.

 $\square''$ Sectional area, 12''.50  $\times$  12''.50 = 156.25.

Weight, 128 lbs.

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
5,000		0		
10,000		.0040		
15,000		.0085		
20,000		.0120		
25,000		.0150		
30,000		.0170		
35,000		.0205		
40,000		.0230		
45,000		.0260		
50,000		.0280		
5,000			.0165	
50,000		.0300		

APPLIED LOADS.		IN GAUGED LENGTH.		REMARKS.
Total lbs.	Lbs. per $\square''$	Compression, inches.	Set, inches.	
60,000		.0335		
70,000		.0385		
80,000		.0440		
90,000		.0500		
100,000		.0570		
5,000			.0340	Crack opened in middle course.
100,000		.0625		
110,000		.0685		
120,000		.0810		
124,900	799	.0900		Ultimate strength.
110,000				Load sustained when test was discontinued.

## N O T E.

Upon examination, it was found that the mortar in most of the piers did not cover the ends completely, so that the covering plates only took bearing over part of the surface. In such cases, plaster of paris was used to fill the spaces and give even bearings; allowing the plaster to set at least twenty-four hours before testing.

Correct.

J. E. HOWARD.

F. H. PARKER,

*Major of Ordnance Commanding.*

## GENERAL ABSTRACT.

Official No. of Test.	Maker of Bricks,	Mortar.	Area in square inches.	Snapping sounds.	Per square inch.	Cracked.	Per square inch.	Ultimate strength.	Per square inch.
3255	Dobbins,	Lime,	165.75	85,000	512	110,000	663	239,000	1442
3256	"	"	162.56	150,000	922	150,000	922	259,100	1594
3257	"	Cement,	169.00	142,000	840	180,000	1065	356,900	2112
3258	"	"	162.56	300,000	1845	300,000	1845	420,000	2584
3259	Huhn,	Lime,	156.25	78,000	499	160,000	1024	299,000	1914
3260	"	Cement,	159.38	320,000	2070	320,000	2070	428,000	2685
3261	Dotterer,	Cement,	156.25			150,000	960	250,000	1600
3262	"	Lime,	156.25			120,000	768	182,400	1167
3263	Excelsior,	Cement,	162.56			240,000	1476	268,900	1654
3264	"	"	159.38	100,000	627	220,000	1380	266,500	1672
3265	"	Lime,	158.76			160,000	1070	178,800	1126
3266	"	"	156.25			100,000	640	124,900	799

## ABSTRACT OF AVERAGE STRENGTHS.

In Lime mortar. *First crack*, 864.23 lbs. square inch, or 62.226 tons square foot.

" Cement " " " 1567.56 " " " 112,864 " " "

In Lime mortar. *Ultimate strength*, 1375 lbs. square inch, or 99 tons square foot.

" Cement " " " 2141.4 " " " 154.18 " " "

JOHN MCARTHUR, JR.,

*Architect.*

# COMMISSIONERS

## For the Erection of the Public Buildings.

PHILADELPHIA, JANUARY 1, 1884.

---

WILLIAM BRICE,	WILLIAM H. LEX,
ISAAC S. CASSIN,	HIRAM MILLER,
MAHLON H. DICKINSON,	RICHARD PELTZ,
THOMAS E. GASKILL,	SAMUEL C. PERKINS,
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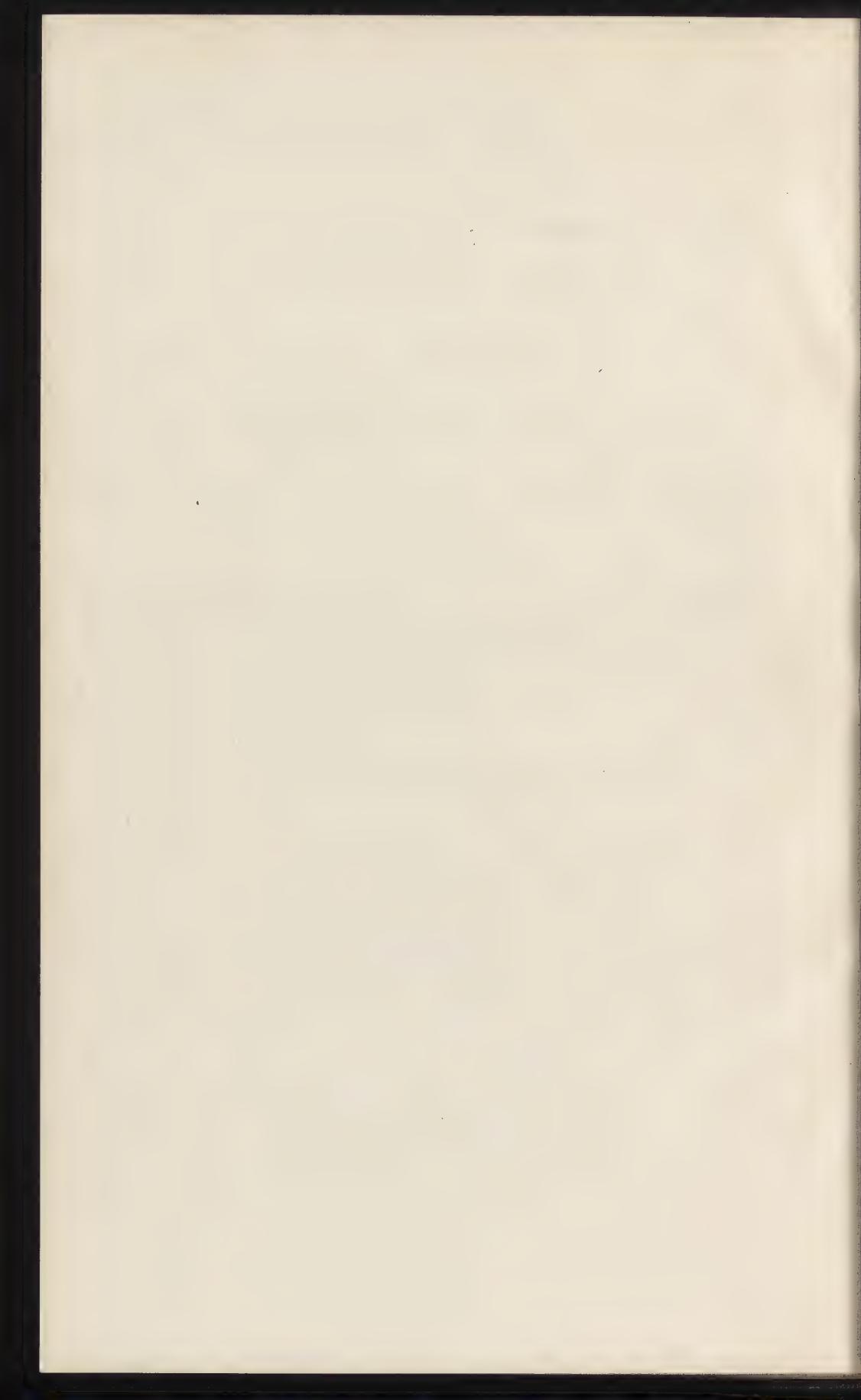
SOLICITOR—CHARLES H. T. COLLIS.

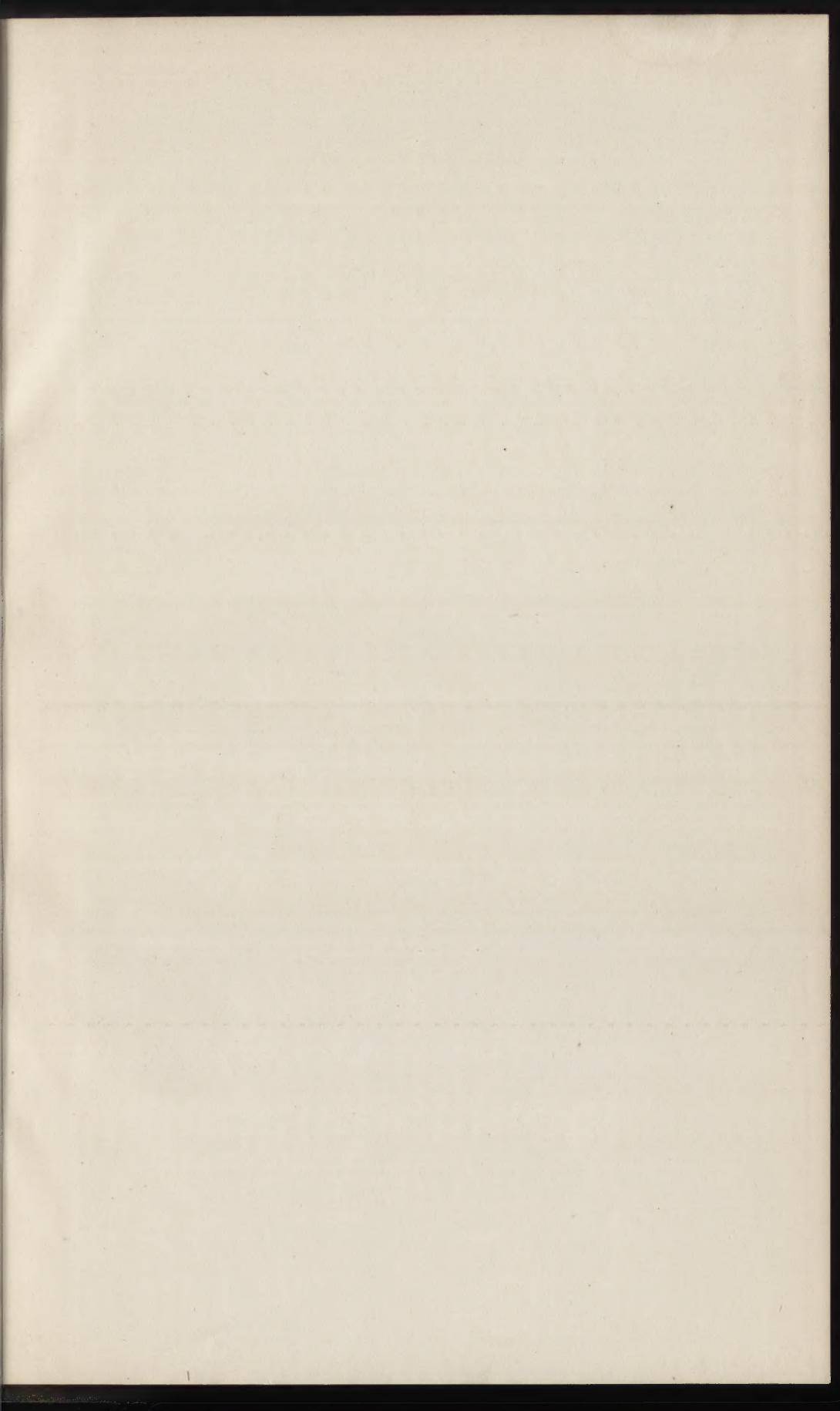
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ARCHITECT—JOHN McARTHUR, JR.

ASSISTANTS—{ JOHN ORD,  
                  THOMAS U. WALTER.

SUPERINTENDENT—WILLIAM C. MCPHERSON.





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